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ABSTRACT

In order to provide an estimate of encoding within the active mode and a comparison between three modes of representation (enactive, imagery, and verbal), 36 second grade children from the high socioeconomic community of Beverly Hills, California, were presented with object pairs under one of three conditions (haptic-object versus visual-object versus aural-label). The pairs were presented for old/new recognition response, and it was found that the children responded better to visual-object than to haptic-object and aural-label presentation. In a second experiment, 54 kindergarden children were presented single objects in the haptic-object mode of study, in order to assess retrieval from the enactive mode. Old/new recognition testing was conducted for objects presented in one of three modes. The pattern of test mode performance suggested that each of the incongruent test conditions produced a decrement in performance relative to the congruent test mode; however, reliable differences between the test modes were not detected. The pattern of performance suggests that visual imagery is a more hospitable mode for the storage of concrete information than either the enactive or verbal, while the similarity of performance in the second experiment suggests that subjects were reasonably efficient at accessing information stored within the enactive mode. (JF)

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Children's Recognition Memory: An Analysis of Haptic, Visual and Verbal Presentation Effects

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Children's Recognition Memory: An Analysis of Haptic, Visual and Verbal Presentation Effects

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Research in children's memory suggests that both verbal and imagery modes of representation can underlie the efficient relational encoding of concrete stimuli (Pressley, 1977; Reese, 1977). Encoding within the different modes can be affected by the mode of stimulus presentation, such that the verbal presentation of object labels elicits primarily verbal representational encoding, while the visual presentation of object pictures elicits primarily imagery representational encoding (cf., Kee, 1976). Research indicates that pictures result in higher levels of paired-associate performance than words (Rohwer, Kee & Guy, 1975), suggesting that the imagery mode of representation is superior to verbal for the encoding of concrete stimuli.

In addition to the verbal and visual-imagery modes of representation, a third enactive mode has been suggested by Bruner (1967) whereby the child can cognitively represent objects by means of actions performed upon them. According to Bruner, the enactive mode is the first mode of representation available to the child. Subsequently, the imagery and verbal modes of representation emerge. While each succeeding mode of representation is posited to supplement rather than replace the preceeding mode, different modes can be expected to predominate at various stages of development.

Research concerning encoding within the enactive mode has been minimal, but suggestive. For example, Irwin (1971) demonstrated that paired-associate

performance is enhanced when children are allowed to handle and look at to-be-remembered (TBR) toy objects relative to merely looking at them side-by-side. Wolff (e.g., Wolff & Levin, 1972; Wolff, Levin, & Longobardi, 1972) has demonstrated improvement in paired-associate learning when children are given an opportunity to act out an interaction with toy objects under an interactive imagery instruction condition relative to a condition in which the children are only given the instructional prompt. A limitation in these studies and others (e.g. Corsini, 1969) is that the effects of haptic manipulation of the objects has not been pure, thereby beclouding the role of enactive representation in children's memory. For example, in the study by Irwin subjects who handled the toy objects also saw the objects side-by-side. In the studies by Wolff, subjects were given a brief look at the TBR toy objects prior to manipulating them behind a screen.

Experiment 1

Experiment 1 was performed to provide an estimate of encoding within the enactive mode and to provide a comparison between the three modes of representation posited by Bruner: enactive, imagery (ikonic) and verbal. Encoding within the different modes was manipulated by varying the mode of stimulus presentation: haptic-object vs. visual-object vs. aural-label. A paired-associate task utilizing a study-test recognition procedure was used. The study trial consists of presenting the TBR stimuli to the subjects, while the test trial consists of presenting both old items (i.e., pairs presented on the study trial) along with new items (i.e., repaired items) to subjects for an old/new recognition response. An important feature of this procedure is that the stimulus presentation is identical at study and test, thereby facilitating a relatively pure estimate of the influence of presentation mode on the storage of to-be-remembered stimuli.

Method

Subjects and Design. Thirty-six second grade children with a mean age of 7.85 years (SD = 4.31, range 7.25 to 8.83) from the high socioeconomic status community of Beverly Hills, California participated in the experiment. The children were randomly assigned to one of the three presentation conditions: haptic-object vs. visual-object vs. aural-label.

Materials and Procedures. A twenty-pair list of common toy objects was assembled for use on the study trial. All toys were small enough (between two and four inches) for the children to hold comfortably in one hand, yet large enough for them to identify by touch alone. Pilot testing with the objects indicated that all were highly identifiable by sight, touch and name with children as young as preschool (e.g., balloon, car, shovel). Item labels were selected by pilot testing with preschool children, utilizing those labels most commonly used by the children. For the test trial this list was altered so that half of the pairs were old (i.e. pairs were identical with the study trial), while half of the pairs were new (i.e., repaired). Two different test lists were used in order to counterbalance old and new pairs such that old pairs in one list would be new (i.e., repaired) items in the other list.

Aural-label presentation consisted of the experimenter naming the TBR toy objects for the child (e.g. balloon-shovel). Each pair was named three times for each child to correspond with the length of time the children would observe the items in the visual-object condition and handle the items in the haptic-object condition. In the visual-object condition the subjects were shown the actual toy objects. The experimenter first presented one item immediately followed by the second, then held the items side-by-side for the duration of the interval. Finally, for the haptic-object presentation

subjects blindly handled each of the objects in the pair. Objects were handed to the children in the same order in which they were named, again to correspond with the aural-label and visual-object presentation conditions. A cardboard box was used in which two holes had been cut out through which subjects could insert their hands. A cloth curtain covered the openings to prevent subjects from seeing the toys. The back of the box was open allowing experimenter to place the toys in subjects' hands. At no time did the subjects see the objects.

Subjects were tested individually in a quiet room. Each subject was seated at a table across from the female experimenter. The subject was told that (s)he was going to play a memory game in which (s)he would handle, see, or be told the names of pairs of toy objects. Subjects were presented with the TBR toy objects at a 10 second rate on the study trial. Pilot testing had indicated that 10 seconds was sufficient time for the subject to correctly identify two objects in the haptic-object mode. Approximately 60 seconds after the completion of this trial a single recognition test trial was administered. This test consisted of the presentation of old and new pairs in a random order for an old/new recognition response. The test mode was identical to the study mode and presentation of TBR objects was pure. Because the test trial was subject paced, a record was kept of the amount of time each subject required to complete the test phase.

Results

The dependent variable selected for analysis was a corrected recognition score (hits minus false alarms). A hit was defined in the scoring procedure as the subject saying "old" to an old pair, while a false alarm was defined as a subject saying "old" to a repaired item. Table 1 presents the means

Insert Table 1 about here

for the experimental conditions. An analysis of variance was performed and indicated a significant main effect for presentation mode, F (2, 33) = 6.41, $p < .01$. Pair-wise comparisons were made by the Scheffé method and revealed that the visual-object condition was associated with a higher level of performance than both the haptic-object and aural-label conditions ($p < .05$), which did not differ from each other ($p > .05$). This outcome suggests that the visual-imagery representational code is more effective than both the verbal and enactive for the storage of concrete stimuli. Since modal age of the children in this study falls roughly within the range of Bruner's ikonic stage, these findings are in concordance with his theory. No longer relying on a predominantly haptic mode of internal representation, the children appear to be utilizing a more developmentally advanced method of internal imagery that enables them to create an image without haptic manipulation although they are still not adept at utilizing labels to represent object names.

It will be recalled that the amount of time required by each subject to complete the self-paced test cycle was recorded. An analysis of the pattern of test time indicated a significant main effect for conditions, F (2, 33) = 42.85, $p < .01$. Scheffé comparisons indicated that subjects required significantly less time to complete the test cycle under aural-label presentation (M = 167.42 sec.) than visual-object presentation (M = 239.83 sec.), which in turn required less time than haptic-object presentation (M = 345.08 sec.), $p < .05$. This pattern of test time performance, however, may be an artifact of the manner in which test stimuli was presented in the different modes. That is, in the aural-label mode experimenter read the labels to the subject which required considerably less time than selecting the pairs of items from their storage compartments and presenting

them for viewing in the visual-object condition or presenting them to the subject for haptic identification in the haptic-object mode.

Experiment 2

The second experiment was conducted to assess retrieval from the enactive mode. In the study, all of the participating subjects studied the TBR items under haptic-object presentation. At test, the mode of presentation was manipulated: haptic-object vs. visual-object vs. aural-label. If haptic-object presentation at study elicits primarily enactive encoding of the TBR items, the congruent test condition (i.e. haptic-object) should be associated with the highest level of performance, while each of the incongruent test conditions (i.e. with study) should produce a performance decrement (cf. Tulving and Thomson, 1971).

Method

Subjects and Design. Preliminary testing indicated that floor effects would have been observed in the incongruent test conditions if the paired-associate procedure were used. Thus, in the second experiment the task was changed so that subjects were required to remember only individual objects as opposed to object pairs. Although it would have been preferable to keep the task constant, research indicates that similar patterns of presentation mode effects are typically observed with paired-associate recognition and item recognition tasks (cf., Bird & Bennett, 1974; Kee, 1976). In addition, to avoid a ceiling effect in the congruent test condition (i.e. haptic-object at study and test) sampling was conducted with kindergarten age children as opposed to the second grade children used in the first experiment. It was expected that the kindergarten age children (relative to the second grade children) would engage in less spontaneous recoding of the

stimulus items at study (e.g. visually imaging the item presented under haptic-object presentation), thereby providing a relatively pure assessment of retrieval from the enactive mode.

Subjects for the second experiment consisted of fifty-four kindergarten grade children with a mean age of 5.97 years (SD = 3.96, range 5.33 to 6.66) drawn from the same elementary schools which provided subjects for the first experiment. The children were randomly assigned to one of the three test conditions (haptic-object vs. visual-object vs. aural-label).

Materials and Procedures. The forty objects from the first experiment plus eight new ones were used. The eight new toys had been pretested with the original forty items to insure that they were readily identifiable by sight and touch and to obtain most frequently used labels. The study trial consisted of the random presentation of thirty-two of the toys at a 5 second rate. 120 seconds after the study trial a single recognition test trial was administered. This consisted of the random presentation of sixteen old items intermixed with sixteen new items for an old/new recognition response. A total of three different study lists and six different test lists were used in order to completely counterbalance old and new items.

Study presentation consisted of experimenter handing subject an individual item. The cardboard box used in Experiment 1 was used. Subjects inserted one hand through each of the holes and used both hands to handle the object. At no time did subjects see the toys. During test trials subjects were handed a single item (haptic-object), shown the item (visual-object), or verbally supplied a label (aural-label). Testing was subject-paced.

Results and Discussion

Similar to Experiment 1 a corrected recognition score (hits minus false alarms) was selected as the dependent variable for analysis. The means for

the test conditions are presented in Table 2. As can be seen, the pattern

Insert Table 2 about here

of test mode performance is consistent with the prediction that a decrement in performance would be associated with the incongruent test modes relative to the congruent test mode (i.e. with study). An analysis of variance, however, failed to detect a reliable main effect for test conditions, $F(2, 51) = 2.08, p > .05$.

An analysis was also conducted on the amount of time required by subjects to complete the test cycle. A significant main effect of conditions was observed, $F(2, 51) = 237.79, p < .01$. Scheffé comparisons indicated that it required more time to complete the test cycle under haptic-object presentation (M = 382.22 sec.) than visual-object presentation (256.78 sec.), which in turn required more than the aural-label presentation (M = 141.44 sec.), $p < .05$. As previously discussed, this pattern of test time may simply reflect the differential amount of time required to present the test stimuli in the three different modes on the test trial.

General Discussion

The superior performance associated with visual-object presentation relative to aural-label presentation in the first experiment is consistent with previous research findings (cf. Pressley, 1977). The results from this experiment also indicate that visual-object presentation is superior to haptic-object presentation and that haptic-object presentation does not differ from aural-label. This pattern of performance clearly indicates that the

visual imagery representational mode is more hospitable for the storage of concrete information than either the enactive or verbal.

The similarity of performance in the different test conditions in Experiment 2 suggests that subjects are reasonably efficient at accessing information stored within the enactive mode. This finding suggests that at test subjects either recode enactive representations available in memory into the representational medium of the incongruent test condition to make a yes/no recognition response or they recode the test stimuli presented in the incongruent test condition into an enactive representation to make a yes/no recognition response. An alternate interpretation of the pattern of test mode performance is that at study, haptic-object presentation elicited representational encoding within all three codes (i.e. enactive, imagery, and verbal), thereby affording equivalent accessibility at test under the different test conditions. This seems unlikely, however, given the substantial differences observed in the first experiment between haptic-object presentation and visual-object presentation.

The results of the present study are consistent with Bruner's notion that three different modes of representation are available in childhood. Bruner has also suggested that the different modes can be expected to predominate at different stages of development. An assessment of potential developmental changes in the relative efficacy of storage and retrival in the three different representational modes is a problem worthy of future investigation.

Table 1

Experiment 1: Mean Corrected Recognition Score as a function of Presentation Condition

Presentation Condition		
Haptic-Object	Visual-Object	Aural-Label
2.75	6.08	2.91

MSE (33) = 6.61

Table 2

Experiment 2: Mean Corrected Recognition Score as a function of Test Condition

Test Conditions		
Haptic-Object	Visual-Object	Aural-Label
12.61	11.44	10.78

MSE (51) = 7.45

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